



Newsletter

Volume 6, Number 4
July - August 1989

Director's Note

Summer at the Institute, as in nature, brings rapid growth in new directions. Scientists from around the world come to do field studies and to collaborate with IES ecologists. Students arrive to do independent study or to work as summer project assistants. This is also the time when IES ecologists are busy doing much of their field work — sampling, measuring, counting, observing, and analyzing data from their research projects.

Summer 1989 brought over 50 visiting scientists and students, and found some of our staff extending their ranges as well. The July-August and September-October issues of the newsletter will highlight some of the past summer's work.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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Who won the root races?

"The Root Race Experiment" is the creation of Dr. Francis Putz. As the 1989 Cary Fellow, Dr. Putz spent the summer at IES, working with IES plant ecologist Dr. Charles Canham on the right-of-way study¹. His research grew from the observation that in abandoned fields, on roadsides and along utility rights-of-way, dense stands of shrubs apparently slow the rate of tree encroachment. Are shrubs more effective competitors than trees, and if so, why? Dr. Putz's root race experiment was one of two ways in which the ecologist set about studying the interactions between trees and shrubs.

Dr. Putz hypothesized that shrubs are more effective than trees in below-ground competition for nutrients. To test this hypothesis, he designed large wooden boxes with Plexiglas sides and a number of "root race courses". He planted seedlings of 4 tree species and 4 shrub species, one seedling per section. By adding slow release fertilizer pellets — lower concentrations near the seedlings and higher concentrations at the Plexiglas end of the course — he provided a nutrient gradient. As soon as a seedling's roots could be seen through the Plexiglas, that seedling was harvested to measure its total root weight.

1. IES ecologists are studying plant-plant, plant-animal and plant-resource relationships along utility rights-of-way, in an effort to develop natural ways to control plant growth (see IES NEWSLETTER Volume 5 Number 3).

There were two ways to "win" the race. One, perhaps the most obvious, was for a root to reach the Plexiglas first. Dr. Putz, however, was more interested in the second, which was for a root to go the farthest with the least expenditure of energy. In typical soil, nutrients tend to occur in patches due to the way that those nutrients are deposited — from a dead animal, rotting leaves, etc. — and a root that can seek out nutrient patches faster or more efficiently is likely to be a more serious competitor. Therefore, the data from the root races should provide an indication of whether shrub roots are more effective foragers than those of trees. The winner of the race was, indeed, a shrub, smooth sumac, but in second and third places were the gray birch and red maple trees. Obviously the story of root foraging is more complicated than originally anticipated.

The root race experiment was done in the IES Greenhouse, but Dr. Putz did the other part of his summer research in three fields — wet, dry and mesic (moderate moisture) — on the Arboretum. Selecting clumps of shrubs in each of these three field types, he planted tree seedlings in the centers: red maple seedlings were planted in smooth sumac and gray dogwood clumps, and white ash in other patches of gray dogwood.

In these experiments, he measured competition for nutrients and water, and

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Dr. Putz with his root race courses.

MICHAEL JOHN

When Shrimp Stir Up the Sand

Throughout tropical and subtropical waters, species of shrimp feed on particles of organic matter in the sand surrounding their deep burrows. As they do so, their back legs move constantly to keep sand from clogging the tunnels. This excavation causes sediment particles to be propelled from the mouths of the burrows. How does this process affect the cycling of organic materials through food chains, and how does it contribute to a healthy marine environment?

When animals living in sediments stir up these sediments through their normal feeding and shelter-building behavior, the process is known as bioturbation. Bioturbation can enhance microbial activity, increase the release of nutrients from sediments, and increase the circulation of oxygen. *Callianassa* is a genus of shrimp that comprises some of the most effective invertebrate bioturbators of sediments in marine waters. These 5 centimeter-long (2 inch) shrimp dig burrows that may reach depths of 3 meters (almost 10 feet). At the top of each burrow is a mound of excavated sand often 30 cm (1 ft.) high. The shrimp are deposit feeders, which means that they collect food particles from the sediments. As they do so, they sort out the finer grained deposits that are richest in organic matter. This sorted material is what gets pushed out of the burrows, where it settles on the sediment surface and may even filter back down into the burrows.

Dr. Thomas S. Bianchi, a post doctoral aquatic ecologist at IES, recently received a special grant from the Bermuda Biological Station for Research (BBSR) to observe and measure bioturbation in an area where *Callianassa* shrimp are plentiful and easily studied. The purpose of this field study was to learn more about the source materials in a marine food chain and the decomposition of organic matter.

Dr. Bianchi's interest in bioturbation began while he worked as a graduate student with Dr. Donald L. Rice, a geochemist at the University of Maryland. Together they examined how *Callianassa* bioturbation affects the chemistry of sediments in the Bahamas. Since his arrival at the Institute a year ago, Dr. Bianchi has been looking at food resources for the Hudson River food chain, but has maintained his interest in food web processes of marine environments as well.

In June Dr. Bianchi spent a week in Bermuda, dividing his time between the BBSR laboratories and Coot Pond, a sheltered bay at the northeast end of the Island where there is a particularly high density of *Callianassa*. The ecologist was



Dr. Bianchi used a pvc coring tube to collect sediments from Coot Pond, Bermuda. Thin sections of the cores were later examined for plant pigments, to learn which plants were important in the local food chain.

especially interested in knowing the importance of land-derived food material relative to marine-derived food material in the nearshore marine food chain. Specifically, did the mangrove leaves that fell off trees on Coot Pond's shores contribute significantly to the marine animals' diets? To help answer the question, he used plant pigments (primarily the chlorophylls and carotenoids that plants require for photosynthesis) as tracers, or clues to the types of plant material that were moving into the food chain in Coot Pond.

Each day, at low tide, he cored into the sediments and carried the full pvc coring tubes back to the laboratory in a cooler strapped to his motorbike. He extruded and sliced the cores at 1 cm (0.39in.) intervals and at the end of his field work brought the slices, frozen and protected from light to prevent pigment degradation, back to his IES laboratory for pigment analysis by a technique known as high pressure liquid chromatography.

Evidence provided by the plant pigments suggests that diatoms — single-celled algae — rather than dead mangrove leaves are the chosen food of *Callianassa*. As the shrimp eat the plant material and stir up the sediments, fragments of the plants and their pigments are deposited. It was the pigment from diatoms that was found distributed, by bioturbation, throughout the cores, indicating the importance of these microscopic plants in the food chain.

But where does the detritus from surrounding mangrove trees go, if not to

the Coot Pond sediments? Dr. Bianchi hypothesizes that this material may travel out to the sediments of the Bermuda Platform and may therefore benefit benthic (sea-bed) communities. The eventual products of the breakdown of mangrove leaves may even be beneficial to Bermuda's reef communities, and might help to compensate for the scarcity of phytoplankton in the surrounding ocean waters.

Dr. Bianchi is using data from his work at the BBSR in a preliminary proposal for a research grant to study the transport and utilization of organic matter in Bermuda Platform sediments. This proposed research could provide an important contribution to coastal studies and to the growing body of knowledge of land margin ecosystems.

At the Perennial Garden This Fall...

- Chrysanthemum nipponicum* (Nippon Daisy)
- Sedum telephium* 'Autumn Joy' (Live-Forever)
- Epimedium* sp. (Barronwort)
- Belamcanda chinensis* (Blackberry Lily)
- Aconitum arendsi* (Monkshood)
- Asarum* sp. (Wild Ginger)
- Ceratostigma plumbaginoides* (Plumbago)
- Boltonia asteroides* 'Snowbank'
- Ornamental Grass Bed



MICHAEL JOHN

On May 1, Gregory R. Long began his duties as the eighth president of The New York Botanical Garden, succeeding Dr. James H. Hester who had been president since 1980. Coming to the Garden from The New York Public Library where he was vice president for public affairs and development, Mr. Long brings experience as a leader in the development of effective administration, resourceful financing and innovative programs for major non-profit institutions. He shows great interest in the research and public education programs of IES, and in August visited the Institute to meet the staff. Here, Mr. Long (r.) discusses Plant Science Building roof renovations with IES director Dr. Gene E. Likens.

New Staff

BERTRAND BOEKEN will be at the Institute for two years as a postdoctoral fellow. Working with Dr. Charles Canham, Dr. Boeken is studying the invasion of the shrub *Cornus racemosa* (gray dogwood) into herbaceous communities along utilities rights-of-way and the expansion of clones after successful colonization. Dr. Boeken has an M.Sc. from Amsterdam University, The Netherlands, and a Ph.D. from Ben-Gurion University of the Negev in Israel.

SANDRA S. HILL, research assistant, assists Dr. Clive Jones on his cottonwood study (see IES NEWSLETTER 6:3). She is currently working to develop a method to analyze cottonwood leaves for naturally occurring chemicals called phenol glycosides. Decreases in these chemicals are believed to be one reason why ozone exposure makes cottonwood leaves more palatable to an insect pest. Ms. Hill has bachelor's degrees in chemistry and medical technology from Hartwick College in Oneonta, New York.

MARK J. MATTSON was appointed postdoctoral associate with Dr. Gene Likens. A graduate student at Cornell University and IES, he did his Ph.D. thesis work on decomposition processes in Mirror Lake (Hubbard Brook

Experimental Forest, New Hampshire). During the summer he worked at Hubbard Brook, overseeing the field laboratory, assisting with computer facilities and continuing studies of Mirror Lake.

ANDREW J. TOBIAS, research assistant, works with manager of laboratory facilities Kathleen Weathers and maintains the IES environmental monitoring program. This program, linked to many of the Institute's long-term research projects, includes an air quality meteorology/station and a stream flow station. After earning a B.S. at SUNY College of Environmental Science and Forestry, Mr. Tobias served four years in the U.S. Coast Guard on board oceanographic/meteorological research vessels.

VOLUNTEERS NEEDED to help in the Gift and Plant Shop.

Requirements? Interest in people, plants and the environment...

Please call Marcia Davis, assistant to the education staff, at 677-5358 if you would like to help out.

Races, from page 1

for sunlight. Four treatments, with replicates, were done in each field. In the first treatment, a trench was dug around the tree seedling and a root barrier was installed; here, then, the tree seedling had unlimited access to water and nutrients, as shrub roots could not invade its root space. In the second treatment, where guy wires were used to hold shrub branches out of the way, the tree seedling was given unlimited sunlight. Treatment #3 consisted of the trenching/root barrier and guy wires, so the tree seedling had no below-ground competition, and unlimited sunlight. The fourth treatment, as in all good scientific experiments, was no treatment: the tree seedling and its surrounding shrubs were left alone, as an experimental control.

Growth of the research plants has been good, and results at the end of Dr. Putz's three-month stay at IES suggested that both below-ground and above-ground competition reduce the growth of tree seedlings. The tree seedlings will be remeasured in October but the final results will not be in until after another growing season.

The results of Dr. Putz's research here will have implications to the management of plant communities along utility rights-of-way and elsewhere. The study is one more example of the importance of addressing fundamental ecological questions to reach answers of interest to managers.

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The Cary Summer Fellowship is an annual award enabling one or more scientists to do research at the Institute. Funds for the award are provided by the Mary Flagler Cary Charitable Trust. Results from the Cary Fellows' short-term projects at IES contribute to the scientists' long-term teaching and research programs at their home institutions.

Dr. Francis E. Putz is an associate professor of botany and forestry at the University of Florida, Gainesville. In his teaching and research he works to bridge the gap between forest ecology and forest management. Most of his field work is done in the tropical rainforests of Southeast Asia and in South and Central America, where he studies the natural factors that limit tree growth. One of his next research expeditions will be to Ecuador, to look at the potential for rejuvenating the button palm as an economic resource for Ecuadorians. Also known as the ivory nut palm or vegetable ivory palm, its extremely hard, white seeds were once used to make high quality buttons.

Fall Calendar

CONTINUING EDUCATION PROGRAM

Classes in Landscape Design, Gardening, Botany, Biological Illustration and Nature Photography begin throughout the fall.

Ecological Excursions and Workshops are also scheduled for fall. Stop by the Gifford House or call the number below for a Continuing Education Program catalogue.

Workshops ... Call to preregister for:

Nov. 4 Planting the Seeds for Your New Business

Nov. 11 Ecological Landscape Assessment

Holiday Workshops, taught by members of the Nine Partners Garden Club, are offered in October, November and December. Call for information.

SUNDAY ECOLOGY PROGRAMS

Free public programs are offered on the first and third Sunday of each month, except over holiday weekends. Tentative schedule (please call (914) 677-5359 to confirm the day's topic):

Oct. 15 — Norway: Fjords, fish ... and acid rain, a talk by Dr. Helge Leivestad

Nov. 5 — Life in the Hudson River, a talk by Dr. Michael Pace

Nov. 19 — A Visit to the Bottom of the Ocean: Research Experience with the ALVIN, a talk by Dr. Jonathan Cole

Dec. 3 — The Hubbard Brook Ecosystem Study, a talk by Dr. Gene E. Likens

These slide presentations begin at 2 p.m. at the Gifford House on Route 44A.

In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the day's program.

IES SEMINARS

The Institute's weekly program of scientific seminars features presentations by visiting scientists or Institute staff. All seminars are held in the Plant Science Building on Fridays at 3:30 p.m. Admission is free. Scheduled for this fall are:

Oct. 13 — The mode of Toxic Action of Acid/Aluminum on Fish, by Dr. Helge Leivestad (Univ. of Bergen, Norway)

Oct. 20 — Topic: Long-term studies on herbivory and plant demography, by Dr. John Thompson (Washington State Univ.)

Oct. 27 — Photosynthesis in Fluctuating Light Regimes, by Dr. Robin Chazdon (Univ. of Connecticut)

Nov. 3 — Topic: Lead biogeochemistry, by Dr. Russ Flegal (Univ. of California at Santa Cruz)

Nov. 10 — Topic: Sulfur biogeochemistry, by Dr. Bob Cook (Oak Ridge National Laboratory, Tennessee)

Nov. 17 — Organic Diagenesis and the Nutrition of Deposit-Feeders, by Dr. Donald L. Rice (Chesapeake Biological Laboratory, Univ. of Maryland)

Dec. 1 — Biological Control of Bracken, by Dr. John H. Lawton (Univ. of York, United Kingdom)

Dec. 8 — Nitrogen Saturation in Forest Ecosystems, by Dr. John Aber (Univ. of New Hampshire)

Dec. 15 — Topic: Global warming, by Dr. George Woodwell (Woods Hole Research Center)

Please call (914) 677-5343 to confirm the week's seminar topic.

ART EXHIBIT

Selected color and black-and-white photographs by Michael J. Doolittle are on display at the Plant Science Building through December 1st.

Hours: 9 a.m. - 4 p.m. weekdays (closed on public holidays). Free.

GREENHOUSE

The IES greenhouse is a year-round tropical plant paradise as well as a site for controlled environmental research. The public is invited to visit the greenhouse during Arboretum hours. There is no admission fee, but visitors should first stop at the Gifford House for a free permit.

GIFT SHOP

Senior Citizens Days: On Wednesdays senior citizens receive a 10% discount on all purchases (except sale items).

Fall bulbs are available.

Look for **early Christmas specials** in October and November, and mark this year's **Christmas Sale**. December 9th and 10th, on your calendar.

ARBORETUM HOURS

(Winter Hours: October 1 - April 30)

The Arboretum is open Monday through Saturday, 9 a.m. to 4 p.m.; Sunday 1 - 4 p.m. The **Gift and Plant Shop** is open Tuesday through Saturday 11 a.m. to 4 p.m. and Sunday 1 - 4 p.m. (closed weekdays from 1 - 1:30 p.m.).

(The Arboretum and Shop are closed on public holidays.)

All visitors must obtain a free permit at the Gifford House for access to the Arboretum. Permits are available up to one hour before closing time.

MEMBERSHIP

Become a member of the Mary Flagler Cary Arboretum. Benefits include a special member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop, free subscriptions to the IES Newsletter and "Garden" magazine, and parking privileges and free admission to the Enid A. Haupt Conservatory at The New York Botanical Garden in the Bronx. Individual membership is \$30; family membership is \$40. For information on memberships, contact Janice Claiborne at (914) 677-5343.

For more information, call (914) 677-5359 weekdays from 8:30 - 4:30

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